PHYSICS

BOOKS - AAKASH SERIES

ALTERNATING CURRENT

Examples

1. Write the general equation for the instantaneous e.m.f of a 50 Hz generator whose peak voltage is 250 V.

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2. The equation of an alternating current is $I = 20 \sin 300\pi t$. Calculate the frequency and r.m.s value of current.

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3. a) The peak voltage of an AC supply is 300 V. What is the rms voltage?

b) The rms value of current in an AC circuit is 10A. What is the peak current?

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4. A 100 Hz a.c. is flowing in a coil of inductance 10 mH. What is the reactance of the coil ?

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5. A 44 mH inductor is connected to 220 V, 50 Hz ac supply. Determine the rms value of the current in the circuit.

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6. Find the maximum value of current when Inductance of two henry is connected to 150V, 50 cycle supply

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7. A $50\mu F$ capacitor is connected to a 100 V, 50 Hz a.c. supply. Determine the rms value of the current in the circuit.

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8. A resistor of 12Ω, a capacitor of reactance 14Ω and a pure inductor of inductance 0.1 Hz are joined in series and placed across a 200 V, 50 Hz a.c. supply. Calculate (i) The current in the circuit and (ii) The phase angle between the current and the voltage. Take $\pi = 3$.

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9. A 50 V, 10 W lamp is run on 100 V, 50 Hz a.c. mains Calculate the inductance of the chock coil required.

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10. A coil of inductance 0.50H and resistance 100 Ω is connected to a 240V. 50Hz ac supply.

(a) What is the maximum current in the coil?

(b) What is the time lag between the voltage maximum and the current maximum?

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11. A series circuit contains a resistor of 20Ω, a capacitor and an ammeter of negligible resistance. It is connected to a source of 200 V, 50 Hz. If the reading of ammeter is 2.5 A, calculate the reactance of the capacitor.

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12. A $100\mu F$ capacitor in series with a 40Ω resistance is connected to a $100V_160Hz$ supply. Calculate (i) the reactance (ii) the impedance and (iii) maximum current in the circuit.

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13. When a capacitor of small capacitance is connected in series with L-R circuit. The alternating current in the circuit increases. Explain why ?

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14. A 100mH inductor, a 25 muF capacitor and a 15 Omega resistor are connected in series to a 120 V. 50 Hz ac, source Calculate

(a) impedance of the circuit at resonance.

(b) current at resonance

(c) resonant frequency

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15. A 100mH inductor, a 25 muF capacitor and a 15 Omega resistor are connected in series to a 120 V. 50 Hz ac, source Calculate

(a) impedance of the circuit at resonance.

(b) current at resonance

(c) resonant frequency

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16. A step-up transformer operates on a 230 V line and supplies a current of 2A. The ratio of

primary and secondary winding is $1:25$. The primary current is

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17. A step down transformer converts a voltage of 2200 V into 220 V in the transmission line. Number of turns in primary coil is 5000. Efficiency of transformer is 90% and its output power is 8kW. Calculate (i) number of turns in secondary coil (ii) input power.

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18. A transformer having efficiency of 90% is working on 200 V and 3kW power supply. If the current in the secondary coild is 6, then the voltage across the secondary coil and the current in the primary coil respectively are

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19. A small town with a demand of 800kW of electric power at 220V is situated 15km away from an electric plant generating power at

440V. The resistance of the two wire line carrying power is 0.5Ω per km. the town gets power from the line through a 4000-220V step-down transformer at a sub-station in the town.

(a) Estimate the line power loss in the form of heat. (b) How much power must the plant supply, assuming there is negligible power loss due to leakage? (c) Characterise the step up transformer at the plant.

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Exercises Long Answer Questions

1. Derive an expression for the impedance of an a.c. circuit consisting of an inductor and a resistor.

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2. In a series LCR circuit, obtain an expression for the resonant frequency.

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Exercies Short Answer Questions

1. Explain instantaneous, maximum, and rms values of a current.

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2. Discuss the flow of a.c. through a pure resistor.

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3. Obtain an expression for the current through an inductor when an AC emf is applied.

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4. Obtain an expression for the current in a capacitor when an a.c.em.f. is applied.

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Exercies Long Answer Questions

1. Where is the power dissipation in an alternating current ? In resistance ? In inductance ? In capacitance ?

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2. What is average value of a.c. over a complete cycle and why ?

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3. The peak value of AC voltage on a 220 V mains is :

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4. What is meant by admittance of an a.c. circuit ?

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5. In an inductor, current rises to a steady value at a constant rate. Comment.

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6. A larger value of Q implies sharper resonance. Comment.

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7. The dimension of $\frac{R}{L}$ are

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8. What is the significance of time constant of R-L circuit ?

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9. Can we use 15 Hz ac for lighting purpose?

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10. A bulb connected in series with a solenoid is lit by a.c. source. If a soft iron core is introduced in the solenoid, will bulb glow brighter ?

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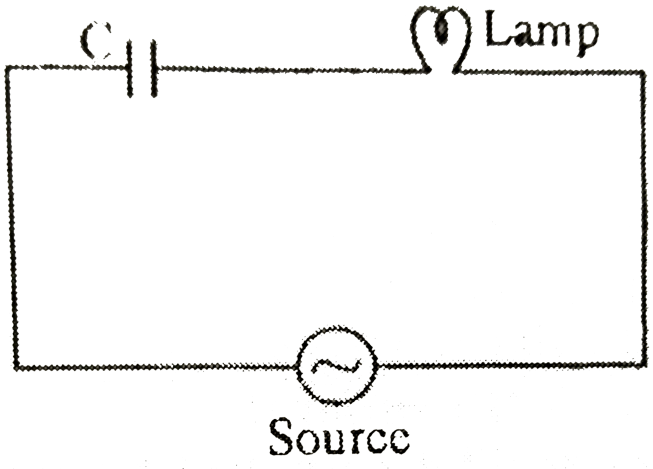
11. An electric lamp having coil of negligible inductance connetced in series with a capacitar and an AC source is glowing with certain brightness. How does the brightness

of the lamp change on reducing the (i) capacitance, and (ii) the frequency ? Justify your answer.



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12. What is the power dissipation in an a.c. circuit in which voltage and current are given

by

$V = 300 \sin(\omega t + \pi/2)$ and $I = 5 \sin \omega t$?

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Problems Level I

1. The equation of alternating current for a circuit is given $I = 50 \cos 100\pi t$. Find (i) frequency of a.c. applied (ii) mean value of current during positive half of the cycle (iii)

virtual value of current and (iv) the value of current 1/300 sec after it was zero

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2. Find the virtual value of current through a capacitor of capacitance $10\mu F$, when connected to a source of 110 volt at 50 cycles supply. What is its reactance ?

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3. A coil of inductance $4/\pi$ H is joined in series with a resistance of 30Ω. Calculate the current flowing in the circuit when connected to a.c. mains of 200 V and frequency 50 Hz.

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4. A circuit consists of a resistance of 10Ω and a capacitance of $0.1\mu F$. If an alternating emf of 100 V, 50 Hz is applied, the current in the current in the circuit is

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5. The current through a 1.0 H inductor varies sinusoidally with an amplitude of 0.5 A and a frequency of 50 Hz. Calculate the potential difference across the terminals of the inductor.

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6. What is the inductive reactance of a coil if the current through it is 80 m A and voltage

across it is 40 V ?

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7. Calculate the frequency at which the inductive reactance of 0.7 H inductor is 220Ω.

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8. What is the capacitance reactance of a $5\mu F$ capacitor when it is part of a circuit whose frequency is (i) 50 Hz (ii) 10^6 Hz ?

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9. A coil of inductance 0.50H and resistance 100 Ω is connected to a 240V. 50Hz ac supply.

(a) What is the maximum current in the coil?

(b) What is the time lag between the voltage maximum and the current maximum?

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10. A resistor of 50Ω, an inductor of $(20/\pi)H$ and a capacitor of $(5/\pi)\mu F$ are connected in series to a voltage source 230 V, 50 Hz. Find the impedance of the circuit.

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11. A $1\mu F$ capacitor is connected to 220 V - 50 Hz a.c. source Find the virtual value of current through the circuit. What is the peak voltage across the capacitor ?

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12. An alternating current of 1.5 mA and angular frequency `omega = 300 rad/s flows through 10 Omega resistor and a 0.50 muF capacitor in series. Find the r.m.s. voltage across the capacitor and impedance of the circuit

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13. A circuit contains a resistance of 40Ω and an inductance of 0.68 H, and an alternating effective e.m.f. of 500 V at a frequency of 120 Hz is applied to it. Find the value of the effective current in the circuit and power factor.

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14. An alternating voltage of 100 virtual volt is applied to a circuit of resistance 0.5Ω and

inductance 0.01 H, the frequency being 50 Hz. What is the current and lag in time between voltage and current ?

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15. A resistor of 100 ohm is connected in series with an inductor of 10H and a capacitor of $0.1\mu F$ All these elements are connected to a 220 volt, 50 Hz a.c. supply. Calculate the total impedance of the circuit.

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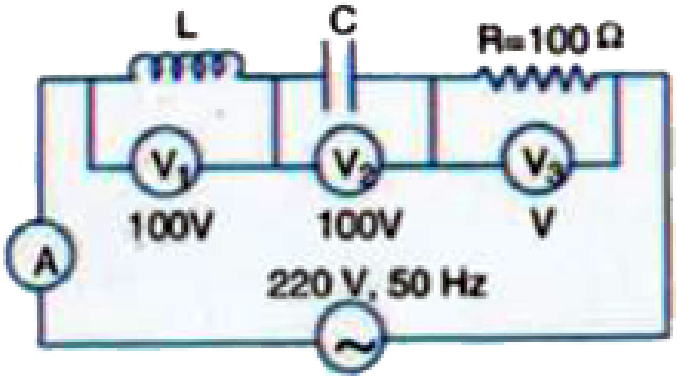
16. In the circuit shown, what will be the reading of the voltmeter V_3 and ammeter A?



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Problem Level Ii

1. An a.c. circuit has a chock coil L and resistance R. The potential difference across the chocke is $v_L = 160V$ and that across the resistance $v_R = 120V$. Find the virtual value of the applied voltage. If the virtual current in the circuit be 1.0 A, then calculate the total impedance of the circuit. If a direct current be passed in the circuit, then what will be the potential difference in the circuit ?

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2. A 12Ω resistance and an inductance of $0.05/\pi$ Hz with negligible resistance are connected in series. Across the ends of this circuit is connected a 130 V alternating voltage of frequency 50 Hz. Calculate the alternating current in the circuit and the potential difference across the resistance and that across the inductance.

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3. A 1.9 H inductor, a $100\mu F$ capacitor and 25Ω resistor are connected in series to an a.c. source whose e.m.f. (in volt) varies with time t (in seconds) according to the expression $E = 282 \sin 100t$. Determine (i) the reactance, (ii) the impedance (iii) the r.m.s. value of the current and (iv) the rate of dissipation of heat

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4. A resistor of 12Ω, a capacitor of reactance 14Ω and a pure inductor of inductance 0.1 Hz are joined in series and placed across a 200 V, 50 Hz a.c. supply. Calculate (i) The current in the circuit and (ii) The phase angle between the current and the voltage. Take $\pi = 3$.

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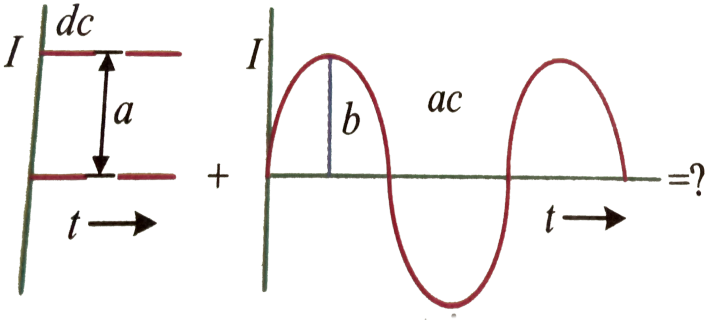
5. If a direct current of value a ampere is superimposed on an alternating current

$1 = b \sin \omega t$ flowing through a wire, what is the effective value of the resulting current in the circuit?



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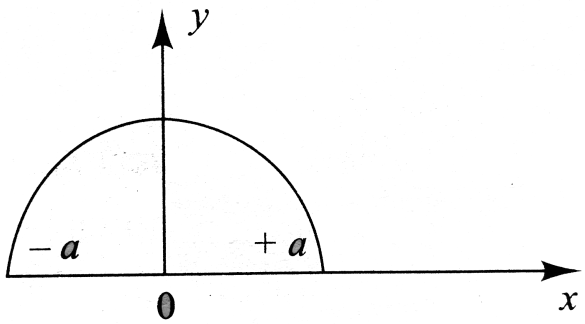
6. Determine the rms value of a semi-circular current wave which has a maximum value of a.



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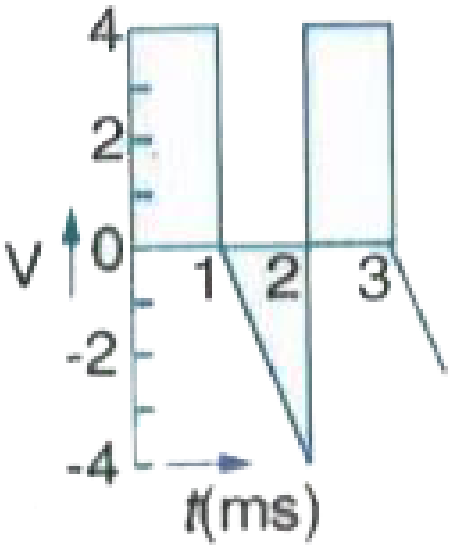
7. Calculate the rms and the average value of the voltage wave shown Fig.



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8. The voltage applied to a purely inductive coil of self inductance 15.9 m H is given by the equation

$V = 100 \sin 314t + 75 \sin 942t + 50 \sin 1570t.$

Find the equation of the resulting current.

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9. For a sinusoidally varying alternating current, what is the ratio of the average value and rms value ?

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Additional Exercise

1. A light bulb is rated at 100W for a 220 V supply. Find (a) the resistance of the bulb, (b) the peak voltage of the source, and (c) the rms current through the bulb.

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2. A pure inductor of 25.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz.

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3. A lamp is connected in series with a capacitor. Predict your observations for dc and ac connections. What happens in each case if the capacitance of the capacitor is reduced?

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4. A 15.0 μF capacitor is connected to a 220 V, 50 Hz source. Find the capacitive reactance and the current (rms and peak) in the circuit. If

the frequency is doubled, what happens to the capacitive reactance and the current?

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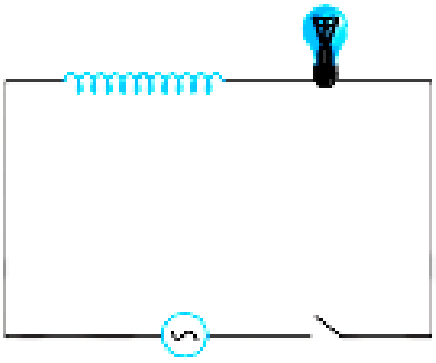
5. A light bulb and an open coil inductor are connected to an ac source through a key as shown in Fig. 7.11.



The switch is closed and after sometime, an

iron rod is inserted into the interior of the inductor. The glow of the light bulb (a) increases, (b) decreases, (c) is unchanged, as the iron rod is inserted. Give your answer with reasons.

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6. A resistor of 200 Ω and a capacitor of 15.0 μF are connected in series to a 22V. 50Hz ac source. (a) Calculate the current in the circuit. (b) Calculate the voltage (rms) across the

resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? if yes, resolve the paradox.

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7. (a) For circuits used for transporting electric power, a low power factor implies large power loss in transmission. Explain.

(b) Power factor can often be improved by the uses a capacitance of appropriate capacitance in the circuit. Explain.

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8. A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a seres LCR circuit in which R $= 3\Omega, L = 25.48mH$. And C=$796\mu F$. Find (a) the impedance of the circuit: (b) the phase difference between the voltage across the source and the current: (c) the power dissipated in the circuit: and (d) the power factor.

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9. Suppose the frequency of the source in the previous example can be varied. (a) What is the frequency of the source at which resonance occurs? (b) Calculate the impedance, the current, and the power dissipated at the resonant condition.

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10. At an airport, a person is made to walk through the doorway of a metal detector, for security reasons. If she/he is carrying anything

made of metal, the metal detector emits a sound. On what principle does this detector work?

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11. Show that in the free oscillations of an LC circuit, the sum of energies stored in the capacitor and the inductor is constant in time.

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Problems

1. Write the general equation for the instantaneous e.m.f of a 50 Hz generator whose peak voltage is 250 V.

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2. The rms value of voltage of an alternator is 200 V and the rms current delivered by it to a load is 3A. If the phase angle between the current and voltage is $\pi / 6$, find the power.

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3. The equation of an alternative currents is $I = 20 \sin 300\pi t$. Calculate the frequency and r.m.s value of current.

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4. (a) The peak voltage of ac supply is 600V. What is its rms voltage?

(b) The rms value of current in an ac circuit is 20 A. What is its peak current?

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5. A current is made of two components, a DC component of $I_1 = 3amp$ and an AC component given by $I_2 = 4\sqrt{2}\sin\omega tamp$, thenthe reading of th hot wire ammetero is : (Read the RMS value)

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6. The electric current in a circuit is given by $i = 3t$. Find the rms current for the period $t = 0$ to $t = 1$ sec.

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7. The electric current in a circuit is given by I = 3 sin $\omega t + 4\cos\omega t$. The rms current is

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8. A vertical circular coil of radius 8 cm and 20 turns is rotated about its vertical diameter with angular velocity 50 rev/s in a uniform horizontal magnetic field of $3 \times 10^{-2} T$. If the coil forms a closed loop of resistance, the average power loss due to joule's heating effect is $(R = 10\Omega)$

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9. A 100 Hz ac is flower in a coil of indnctance 10 mH. What is the reactance of the coil?

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10. A 44 mH inductor is connected to 220 V, 50 Hz ac supply. Determine the rms value of the current in the circuit.

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11. The voltage applied to a supply inductive coil of self inductance 15.9 mH is given by the equation

$$V = 100 \sin 314t + 75 \sin 942t + 50 \sin 1570t.$$

Find the equation for current wave.

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13. A $50\mu F$ capacitor is connected to a 100 V, 50 Hz ac supply. Determine the rms value of the current in the circuit.

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14. A 50V, 10 W lamp is run on 100V, 50Hz ac mains Calculate the inductance of the choke coil required.

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15. A coil of inductance 0.50 H and resistance 100 ohm is connected to 240 V, 50Hz ac supply. What is the peak current in the coil?

b) What is the time lag between the peak voltage and the peak current?

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16. A series combination of a coil of inductance L and a resistor of resistance 12Ω is connected

across a 12 V, 50 Hz supply. Calculate L if the circuit current is 0.5 A.

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17. A series circuit contains a resistor of 20Ω, a capacitor and an ammeter of negligible resistance. It is connected to a source of 200 V, 50 Hz. If the reading of ammeter is 2.5 A, calculate the reactance of the capacitor.

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18. A $10\mu F$ capacitor is in series with a 50Ω resistance and the combination is connected to a 220 V, 50 Hz line. Calculate (i) the capacitive reactance, (ii) the impedance of the circuit and (iii) the current in the circuit.

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19. An inductor, a capacitor and a resistor are in series with an alternator of frequency 50Hz. The potential difference across them are 50 V,

80 V and 40 V respectively. Find the voltage of the alternator?

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20. A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a seres LCR circuit in which R $= 3\Omega, L = 25.48mH$. And C=$796\mu F$. Find (a) the impedance of the circuit: (b) the phase difference between the voltage across the source and the current: (c)

the power dissipated in the circuit: and (d) the power factor.

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21. When a capacitor of small capacitance is connected in series with series $L - R$ circuit. The alternating current in the circuit increases. Explain why?

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22. In series $L-C-R$ circuit, $L=2.0H, C=32\mu F$ and $R=10\Omega$ find Q - factor of resonance circuit.

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23. A 100mH inductor, a 25 muF capacitor and a 15 Omega resistor are connected in series to a 120 V. 50 Hz ac, source Calculate

(a) impedance of the circuit at resonance.

(b) current at resonance

(c) resonant frequency

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24. A transformer has 400 primary turns and 300 secondary turns. If the operating voltage for the load connected to the secondary is measured to be 300 V, what is the voltage supplied to the primary?

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25. A step-up transformer operates on a 230 V line and supplies a current of 2A. The ratio of primary and secondary winding is $1:25$. The primary current is

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26. A small town with a demand of 800 kW of electric power at 220 V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5Ω per km. The town gets

power from the line through a 4000-220 V step down transformer at a substation in the town . The line power loss in the form of heat is

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27. A step down transformer converts a voltage of 2200 V into 220 V in the transmission line. Number of turns in primary coil is 5000. Efficiency of transformer is 90% and its output power is 8kW. Calculate (i)

number of turns in secondary coil (ii) input power.

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28. A transformer having efficiency 90% is working on 100 V and at 2.0 kW power. If the current in the secondary coil is 5A, calculate (i) the current in the primary coil and (ii) voltage across the secondary coil.

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Exercise Ia

1. The resistance of a coil for DC is 5Ω . In case of AC, the resistance will

A. will remain 5Ω

B. will decrease

C. will increase

D. will be zero

Answer: C

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2. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when

A. Frequency of the AC source is decreased

B. Number of turns, in the coil is reduced

C. A capacitance of reactance $X_C = X_L$ is included in the same circuit

D. An iron rod is inserted in the coil

Answer: D

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3. An AC source is connected to a capacitor. The current in the current is I. Now a dielectric slab is inserted into the capacitor , then the new current is

A. equal to I

B. more than I

C. less than I

D. sometimes more and sometimes less than I

Answer: B

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4. Voltage and current in an AC circuit are given by V = 5sin(100πt-π/6) and I = 4sin(100π t+π/6)

A. voltage leads the current by 30°

B. current leads the voltage by 30°

C. current leads the voltage by 60°

D. current are voltage are in phase

Answer: C

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5. The graphs given below depict the dependence of two reactive impedances X_1 and X_2 on the frequency of the alternating e.m.f. applied individually to them.

We can then say that

A. X_1 is an inductor and X_2 is a capacitor

Freuency

B. X_1 is a resistor and X_2 is a capacitor

C. X_1 is a capacitor and X_3 is an inductor

D. X_1 is an inductor and X_2 is a resistor

Answer: C

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6. A series L-C-R circuit is operated at resonance . Then

A. $\left[R^2+\left(\omega L-\frac{1}{\omega C}\right)^2\right]^{1/2}$

B. $\left[R^2+\left(\omega L+\frac{1}{\omega C}\right)^2\right]^{1/2}$

C. $\left[R^2+\left(\frac{1}{\omega C}-\omega L\right)^2\right]^{1/2}$

D. R

Answer: D

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7. In an AC series circuit when the instanteous source voltage is maximum, the instantaneous current is zero.Connected to the source may be a

A. pure inductor

B. pure capacitor

C. pure resistor

D. combination of a capacitor and an inductor

Answer: A

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8. The phase difference between the alternating current and emf is $\pi/2$.Which of the following cannot be the consituent of the circuit?

A. C alone

B. R, L

C. L, C

D. L alone

Answer: B

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9. A transistor -oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to 4 C, the frequency will be

A. $f/4$

B. $8f$

C. $f/2\sqrt{2}$

D. $f/2$

Answer: C

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10. What is the mechanical equivalent of spring constant k in LC oscillating circuit?

A. $\frac{1}{L}$

B. $\frac{1}{C}$

C. $\frac{L}{C}$

D. $\frac{1}{LC}$

Answer: B

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11. In LCR - circuit if resistance increases, quality factor

A. increases finitely

B. decreases fainitely

C. remains constant

D. none of these

Answer: B

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12. To reduce the resonant frequency in an LCR series circuit with a generator

A. the generator frequency should be reduced

B. another capacitor should be added in parallel to the first

C. the iron core of the inductor should be removed

D. dielectric in the capacitor should be removed

Answer: B

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13. A resistance R draws power P when connected to an AC sourc.e If an inductance is now placeld in sereis with the resistance, such that impedance of the circuit becomes Z the power drawn will be

A. $P\left(\frac{R}{Z}\right)^2$

B. $P\sqrt{\frac{R}{Z}}$

C. $P\left(\frac{R}{Z}\right)$

D. P

Answer: A

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14. A series $R-C$ circuit is connected to an alternating voltage source. Consider two situations:

1 When capacitor is air filled.

2 When capacitor is mica filled.

Current through resistor is i and voltage across capacitor is V then

A. $V_a = V_b$

B. $V_a < V_b$

C. $V_a > V_b$

D. $i_a = i_b$

Answer: C

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15. The core of a transformer is laminated to reduce

A. Eddy currents

B. Hysteresis

C. Resistance in winding

D. None of these

Answer: A

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Exercise Ib

1. Assertion : At resonance, LCR series circuit have a minimum current.

Reason : At resonance, in LCR series circuit, the

current and e.m.f. are not in phase with each other.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: D

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2. Statement 1: Both dc and ac can be measured by a hot wire instrument.

Statement 2: the hot wire instrument is based on the principle of magnetic effect of current.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: C

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3. Assertion: At resonance, power factor of L-C-R series circuit is 1.

Reason: At resonance, $X_C = X_L$

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: A

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4. Assertion: If an inductor coil is connected to DC source, the current supplied by it is I_1. If the same coil is connected with an AC source

of same voltage. Then current is I_2, then $I_2 < I_1$.

Reason: In AC circuit, inductor coil offers more resistance.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: A

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5. Assertion: An AC can be transmitted over long distances without much power loss.

Reason: An AC can be stepped up or down with the help of a transformer.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: A

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6. Assertion: Inductive reactance of an inductor in DC circuit is zero.

Reason: Angular frequency of DC circuit is zero.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: A

 Watch Video Solution

7. A : An inductor and a capacitor are called low pass filter and high pass filter respectively.

R : Reactance of an inductor is low for low frequency signals and that of a capacitor is high for high frequency signals.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: C

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8. A : Wires of the transmission lines carrying A.C. are made of multiple stands.

R : A.C. flows on surface of the conductor.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: A

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9. A : The ammeters and volmetrs used for measuring alternating current and voltages have non-uniform divisons on their scales.

R : The instruments used for measuring alternating current and voltage are based on heating effect of current.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: A

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10. A : A series resonant circuit is also known as an acceptor circuit.

R : For large value of Ohmic resistance, the quality factor of a series resonant circuit is high.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: C

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11. A : For a practicval choke coil the power factor is very small.

R : In a practical choke coil the power dissipation reduces if frequency of the a.c. is increased.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: B

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12. A : If a current has both ac and dc components, then a dc ammeter used to measure this current will measure the average value of the total current.

R : The scale of a dc ammeter is uniformly divided.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: B

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13. Assertion : Faraday's law are consequences of conservation of energy .

Reason : In a purely resistive of A.C. circuit ,the current legs behind the e.m.f. in phase .

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: C

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14. Assertion : The alternating current lags behind the e. m. f. by a phase angle of $(\pi/2)$ when AC flows through an inductor.

Reason : The inductive reactance increases as the frequency of AC saource decreases.

A. Both 'A' and 'R' are true and 'R' is the correct explanation of 'A'.

B. Both 'A' and 'R' are true and 'R' is not the correct explanation of 'A'

C. 'A' is true and 'R' is false

D. Both 'A' and 'R' are false

Answer: C

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Exercise Ii

1. The peak value of an alternating $e.m.f$ given by $E = E_{\circ} \cos \omega t$ is 10 volt and frequency is $50Hz$.At time $t = (1/600)\text{sec}$, the instantaneous value of $e.m.f$ is

A. 1V

B. 5V

C. $5\sqrt{3}V$

D. 10V

Answer: C

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2. The potential difference across the resistance, capacitance and inductance are 80V, 40V an 100V respectively in an L-C-R circuit. The power factor of this circut is

A. 0.4

B. 0.5

C. 0.8

D. 1

Answer: C

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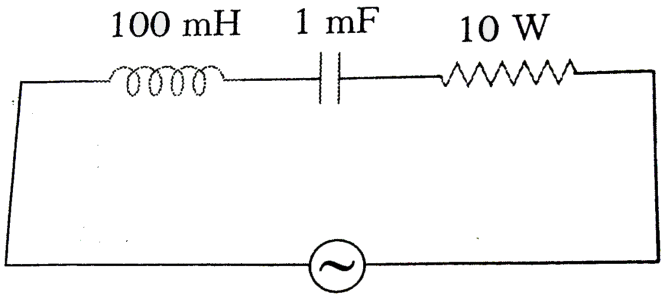
3. The following series L-C-R circuit , when driven by an emf source of angular frequency 70 kilo-radians per second , the circuit effectively behaves like



A. purely resistive circuit

B. series R -L circuit

C. series R - C circuit

D. series L- C circuit with R = O

Answer: C

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4. In a circuit L, C and R are connected in series with an alternating voltage source of

frequency f. The current leads the voltage by 45°. The value of C is -

A. $\frac{1}{2\pi f(2\pi fL + R)}$

B. $\frac{1}{\pi f(2\pi fL + R)}$

C. $\frac{1}{2\pi f(2\pi fL - R)}$

D. $\frac{1}{\pi f(2\pi fL - R)}$

Answer: A

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5. The magnetic field energy in an inductor changes from maximum value to minimum value in $5.0ms$ when connected to an AC source. The frequency of the source is

A. 20 Hz

B. 50Hz

C. 200Hz

D. 500Hz

Answer: B

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6. A coil of inductive reactance 31Ω has a resistance of 8Ω. It is placed in series with a condenser of capacitive reactance 25Ω. The combination is connected to an ac source of $110V$. The power factor of the circuit is

A. 0.56

B. 0.64

C. 0.8

D. 0.33

Answer: C

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7. In a transformer , number of turns in the primary are 140 and that in the secondary are 280 . If current in primary is 4 A, then that in the secondary is

A. 4A

B. 2A

C. 6A

D. 10A

Answer: B

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8. A transformer has 1500 turns in the primary coil and 1125 turns in the secondary coil. If a voltage of 200V is applied across the primary coil , then the voltage in the secondary coil is :

A. 100 V

B. 150 V

C. 200 V

D. 250 V

Answer: B

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Exercise Iii

1. If the alternating current I $= I_1 \cos \omega t + I_2 \sin \omega t$, then the rms current

is given by

A. $\frac{i_1 + i_2}{\sqrt{2}}$

B. $\frac{|i_1 + i_2|}{\sqrt{2}}$

C. $\frac{\sqrt{i_1 + i_2}}{2}$

D. $\frac{\sqrt{i_1^2 + i_2^2}}{\sqrt{2}}$

Answer: D

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2. In a heating arrangement , an alternating current having a peak value of 28 A is used . To produce the same heat energy , If the constant current is used, its magnitude must be

A. about 14 A

B. about 28 A

C. about 20 A

D. cannot say

Answer: C

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3. In an AC circuit, the applied potential difference and the current flowing are given by $V = 20\sin 100t$ volt ,$I = 5\sin\left(100t - \frac{\pi}{2}\right)$ amp

The power consumption is equal to

A. 1000W

B. 40 W

C. 20 W

D. zero

Answer: D

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4. The instantaneous values of alternating current and voltages in a circuit are given as

$$i = \frac{1}{\sqrt{2}}\sin(100\pi t) \quad \text{ampere}$$

$$e = \frac{1}{\sqrt{2}}\sin(100\pi t + \pi/3)\text{volt}$$

The average power in Watts consumed in the circuit is -

A. $\frac{1}{4}$

B. $\frac{\sqrt{3}}{4}$

C. $\frac{1}{2}$

D. $\frac{1}{8}$

Answer: D

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5. An ideal choke takes a current of 10 A when connected to an ac supply of 125 V and 50 Hz. A pure resistor under the same conditions takes a current of 12.5 A. If the two are

connected to an ac supply of 100 V and 40 Hz, then the current in series combination of above resistor and inductor is

A. $7A$

B. 12.5 A

C. 20 A

D. 25 A

Answer: A

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6. An ideal choke takes a current of $8A$ when connected to an a.c. source of 100 volt and $50Hz$. A pure resistor under the same conditions takes a current of $10A$. If two are connected in series to an $a.c.$ supply of $100V$ and $40Hz$, then the current in the series combination of above resistor and inductor is

A. 10A

B. 8A

C. $5\sqrt{2}A$

D. $10\sqrt{2}A$

Answer: C

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7. When 100 V DC is applied across a solenoid , a current of 1 A flows in it. When 100 V AC is applied across the same solenoid the current drops to 0.5A . If the frequency of the AC source is 50 Hz , the impedance and inductance of the solenoid are

A. 200Ω and 0.551H

B. 100Ω and 0.86H

C. 200Ω and 1.0H

D. 1100Ω and 0.93H

Answer: A

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8. In an L-R circuit, the inductive reactance is equal to the resistance R of the circuit. An emf $E = E_0 \cos \omega t$ is applied to the circuit. The power consumed in the circuit is

A. $\frac{E_0^2}{\sqrt{2}R}$

B. $\frac{E_0^2}{4R}$

C. $\frac{E_0^2}{2R}$

D. $\frac{E_0^2}{8R}$

Answer: B

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9. An alternating voltage E = $200\sqrt{2}\sin(100t)$ is connected to a μF capacitor through an AC

ammeter. The reading of the ammeter shall be

A. 20 mA

B. 40 mA

C. 30 mA

D. $10\sqrt{2}$ mA

Answer: A

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10. At a frequency ω_0 the reactance of a certain capacitor equal that of a certain inductor. If the frequency changed to $2\omega_0$. What is the ratio of the reactance of the inductor to that of the capacitor?

A. $4:1$

B. $\sqrt{2}:1$

C. $1:2\sqrt{2}$

D. $1:2$

Answer: A

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11. An L-C-R series circuit consists of a resistance of 10Ω a capacitor of reactance 60Ω and an inductor coil . The circuit is found to resonate when put across a 300 V , 100 Hz supply . The inductance of coil is (take π = 3)

A. 0.1 H

B. 0.01 H

C. 0.2 H

D. 0.02 H

Answer: A

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12. An L-C-R seriescircuit with a resistance of 100Ω connected to an AC source of 200V (rms) and angular frequency $300rod/s$. When only the capacitor is removed, the current lags behind the voltage by 60°. When only the inductor is removed the current leads the

voltage by 60° . The average power dissioated in original L-C-R circuit (50x) Watt. Find the value of x.

A. 0.5A

B. 1.5A

C. 2A

D. 2.5A

Answer: C

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13. An electric lamp designed for operation on 110 V AC is connected to a 220 V AC supply , through a choke coil of inductance 2H, for proper operation. The angular frequency of the AC is $100\sqrt{10}$ rad/s . If a capacitor is to be used place of the choke coil, its capacitance must be

A. $1\mu F$

B. $2\mu F$

C. $5\mu F$

D. $10\mu F$

Answer: C

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14. In a series LCR circuit the frequency of a $10V$, AC voltage source is adjusted in such a fashion that the reactance of the inductor measures 15Ω and that of the capacitor 11Ω. If $R = 3\Omega$, the potentail difference across the series combination of L and Cwill be:

A. 8V

B. 10V

C. 22V

D. 52V

Answer: A

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15. A circuit draws 330 W from a 110 V , 60 Hz AC line. The power factor is 0.6 and the current lags the voltage. The capacitance of a series

capacitor that will result in a power factor of unity is equal to

A. $31\mu F$

B. $54\mu F$

C. $151\mu F$

D. $201\mu F$

Answer: C

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16. The natural frequency of an L-C circuit is 125000 cycles/s. When a dielectric medium of dielectric constant K is introduced between the plates of the capacitor, the frequency decreases by 25 kHz. The value of K is

A. 3

B. 2.1

C. 1.56

D. 1.7

Answer: C

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17. The self inductance of the motor of an electric fan is 10 H. In order to impart maximum power at 50 Hz, it should be connected to a capacitance of:

A. $4\mu F$

B. $8\mu F$

C. $1\mu F$

D. $2\mu F$

Answer: C

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18. In an oscillating L-C circuit, the maximum charge on the capacitor is Q The charged on the capacitor, when the energy is stored equally between the electric and magetic field is

A. $\frac{Q}{2}$

B. $\frac{Q}{\sqrt{2}}$

C. $\frac{Q}{\sqrt{3}}$

D. $\frac{Q}{3}$

Answer: B

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19. Powre dissipated in an LCR series circuit connected to an ac source of emf ε is

A. $\frac{\varepsilon^2 R}{\left[R^2 + \left(L\omega - \frac{1}{C\omega}\right)^2\right]}$

B. $\frac{\varepsilon^2\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}{R}$

C. $\frac{\varepsilon^2\left[R^2+\left(L\omega+\frac{1}{C\omega}\right)^2\right]}{R}$

D. $\frac{\varepsilon^2 R}{\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}$

Answer: A

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20. Which of the following combination should be selected for better tuning of an LCR circuit

used for communication?

A. $R = 15\Omega, L = 3.5H, C = 30\mu F$

B. $R = 25\Omega, L = 1.5H, C = 45\mu F$

C. $R = 20\Omega, L = 1.5H, C = 35\mu F$

D. $R = 25\Omega, L = 2.5H, C = 45\mu F$

Answer: A

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21. A small town with a demand of 800 kW of electric power at 220 V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5Ω per km. The town gets power from the line through a 4000-220 V step down transformer at a substation in the town . The line power loss in the form of heat is

A. 400 kW

B. 600 kW

C. 300kW

D. 800kW

Answer: B

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22. A 220 V input is supplied to a transformer. The output circuit draws a current of 2 A at 440 V. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is

A. 3.6 A

B. 2.8 A

C. 2.5 A

D. 5.0 A

Answer: D

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23. A transformer having efficiency of 90% is working on 200 V and 3kW power supply. If the current in the secondary coild is 6, then the

voltage across the secondary coil and the current in the primary coil respectively are

A. 300 V, 15 A

B. 450 V, 15 A

C. 450 V, 13.5 A

D. 600 V, 15 A

Answer: B

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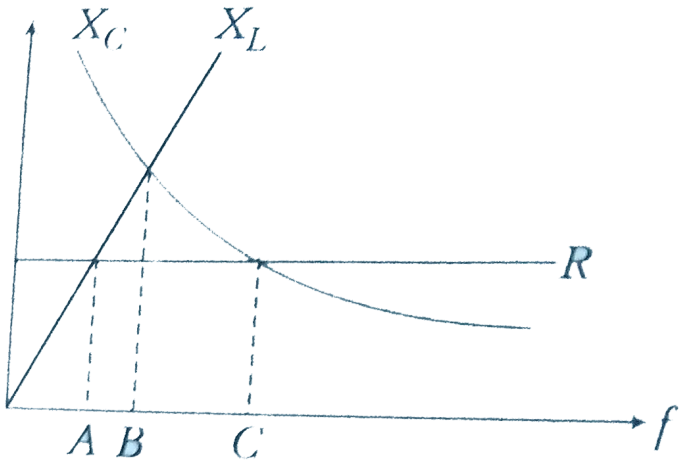
24. The figure shows variation of R, X_L and X_C with frequency f in a series L, C , R circuit . Then , for what frequency point, the circuit is inductive?



A. A

B. B

C. C

D. All points

Answer: C

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